## Vehicle Systems

# Heavy Vehicle Duty Cycle

### Background

The U.S. trucking industry involves considerable use of class 8 trucks and operates in relatively small fleets; 50% of the fleets in the U.S. comprise less than 100 trucks and 25% are less than 10 trucks). The industry operates on a small profit margin and is faced with regulatory and economic pressures. Making heavy trucks more efficient through new technologies and fleet management protocols would reduce dependence on oil and release of emissions into the environment, as well as contribute to larger profit margins. Since efficient systems are typically inherently safer, lives could also be saved.

One obstacle involves knowing what the true benefits are of new energy efficient technologies. Most benefit assessments are based on existing information on heavy truck operation. Much of this information is stylized and based on duty cycles that are meant to test various emission or fuel economy measurements. For example, the FTP Transient Cycle is a transient engine dynamometer cycle for heavy-duty truck and bus engines. It includes segments designed



*Figure 1.* *Dana tractor/trailer being fitted with sensors and data acquisition system.*

to simulate both urban and freeway driving and used for emission certification testing of heavy-duty diesel engines in the United States. Another example is the Urban Dynamometer Driving Schedule (UDDS), which is an EPA transient chassis dynamometer test cycle for heavy-duty vehicles. While cycles such as these are based on an understanding of the vehicle technologies and how the best vehicles might be tested to assess emissions and fuel economy, they do not accurately reflect real world driving.

### Benefits

- Supports the development and calibration of Argonne National Laboratory's PSAT Class 8 module.

- Supports the development of a tool to generate customized duty-cycles for input to simulation models and other applications.

- Enables better-informed technology investment decisions.

How trucks actually operate on highways is not well understood. Only an experienced heavy truck driver has a true situational awareness of the characteristics of driving on our nation's highways. There are many factors that affect operations, such as

- rules on hours of operation,

- recurring congestion in urban envrionments,

- non-recurring congestion (road construction or accidents, for example),

- anti-idling regulations,

- differing fleet management philosophies,

- weather, and

- topological conditions.

A better understanding of the effects these and other factors have on driving would be a valuable asset to DOE, other federal agencies, and the trucking industry as they evaluate technologies for their effects on energy efficiency, safety, emissions, fleet management, and so forth. Capturing data on the nature and characteristics of heavy truck driving will lead to a better understanding of heavy truck operations and more representative duty cycles, factors which are critical for accurate analytical evaluations of new technologies.

## Technology

An unprecedented suite of sensors and instruments is being used to measure and record over 90 different parameters (e.g., vehicle speed, acceleration, load, grade, wind velocity) from the operation of a heavy line-haul truck running on a dedicated route between Portland, Oregon, and Chicago, Illinois. The data collected will be analyzed to provide a basis for defining a heavy vehicle duty cycle.

This duty cycle represents the environment, speed, load, etc., experienced by heavy trucks and can serve as a universal basis for evaluating and comparing numerous figures of merit such as fuel economy, emissions, and performance. The project is led by Oak Ridge National Laboratory, with partners Dana Corporation of Kalamazoo, Michigan; Michelin Tire of Greenville, South Carolina; and support from Argonne National Laboratory.

## Status

Two pilot runs from Bangor, Maine, to Miami, Florida, have been completed. The purpose of these runs was to evaluate the data acquisition systems and on-board data collection suites for field-hardening purposes. The pilot runs generated preliminary duty cycle information as a proof of concept. Results from the pilot runs will be utilized in a 12-month fleet-based test utilizing up to 10 instrumented class 8 tractor-trailers engaged in normal long-haul vocational activities.

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